

REMARKS

Reconsideration is respectfully requested.

Status of Claims

Claims 1 - 17 were previously canceled without prejudice of the subject matter therein. Claims 18 - 67 are presently pending.

Applicants presently cancel claims 19 - 21, 28 - 30, 38 - 41, 43 - 51, 53 - 59 and 67 without prejudice or disclaimer, amend claims 18, 23, 24, 27, 32 - 35, 42, 52, 60, 61 - 66, and add new claims 68 and 69. No new matter is added.

Allowed Claim

Applicants thank the Examiner for indicating that claim 60 is presently allowed. Applicants amend allowed claim 60 to address certain informalities, which do not alter the basis in which claim 60 was allowed ("because none of the cited or applied prior art shows or fairly suggests employing a rotation mechanism with the sintering plate to enable the sintering plate to rotate about a vertical axis). A reference relevant to allowed claim 60 was disclosed in an Information Disclosure Statement filed on February 8, 2008 (Kenneth J. A. Brookes, "Hardmetals and other Hard Materials." International Carbide Data, U.K, 1992, pages 19, 43, hereinafter "Brookes"), At page 43, Brookes provides a photograph discloses a pick and place device for placing compacts to be sintered on a round sintering plate.

While the photograph depicts compacts on the sintering plate as having various orientations, Brookes is silent about the mechanism used to place the compacts at these various orientations. Thus, while it is possible for example that this placement is accomplished by rotating the sintering plate, it is not certain as it is also possible that the placement is accomplished by rotating components of the pick and place device.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. v. Union Oil*

Co. of California, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). MPEP § 2163.07(a) sets forth the requirements for finding that a claimed element is inherently described:

"To establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.'" *In re Robertson*, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999) (citations omitted).

For the above-discussed reasons, Applicants submit that Brookes does not inherently disclose Applicants' claimed rotation mechanism for rotating a sintering plate. Applicants maintain therefore that amended claim 60 is not anticipated by Brookes, and is allowable.

Applicants add new claim 69 which depends from allowable claim 60 and in addition recites that the conveyance mechanism for holding and conveying the plurality of green has a rotation mechanism for rotating each held green component around an axis of the conveyance mechanism. As Brookes fails to clearly describe or otherwise disclose an apparatus having a first rotation mechanism for rotating and positioning a sintering plate and a second rotation mechanism for rotating each compact held by a conveyance mechanism around an axis of the conveyance mechanism, Applicants submit that new claim 69 is not anticipated by Brookes, and is therefore allowable.

Objections to the Claims

Claims 61 - 67 are objected to under 37 C.F.R. §1.75(c) as being improper for failing to further limit the subject matter of the claims from which claims 61 - 67 depend. Former claim 61 was directed to an apparatus including a plurality of green compacts, and depended from claim 60, which is directed to an apparatus for aligning a plurality of green compacts. Applicants amend claim 61 to place it in independent form by claiming an apparatus for manufacturing throwaway tips that incorporates the elements of former claim 60. In addition, Applicants cancel claim 67 without prejudice or disclaimer, and incorporate the limitations of canceled claim 67 and associated

filling raw material powder into a cavity formed in a die;
press forming said raw material powder to form a plurality of green compacts,
placing said green compacts on a sintering plate having a center; and
sintering said green compacts simultaneously to form said sintered articles,
wherein each of said green compacts is formed having at least one of a density gradient or a dimensional gradient, said at least one gradient decreasing in a predetermined direction across said green compact, and
wherein each of said green compacts is substantially oriented on said sintering plate in plan view with said gradient decreasing outwardly from the center of said sintering plate.

(Emphasis added).

The Invention

As described for example at page 2, lines 11 - 23 of Applicants' specification, it is known in the field of powder metallurgy that non-uniform shrinkage of green compacts during sintering can be attributed to a non-uniform material density of the green compacts prior to sintering. Thus, there has been significant discussion in the literature with regard to research for improving the uniformity of the material densities of green compacts.

The inventors of the present invention undertook a detailed study as to the shape and positioning of green compacts within sintering ovens, and discovered that the deformation (i.e. non-uniform shrinkage) of green compacts during sintering occurs in a predetermined pattern. The present invention, as claimed for example in amended independent claim 18, is directed to exploit this discovery.

As illustrated, for example, in Applicants' FIG. 12, square green compacts Q become distorted during the sintering process, such that an edge b which is positioned closest to the center of the sintering plate shrinks more than an opposite edge a which is farther away from the center of the sintering plate. As a result, the throwaway tips T after sintering deform to assume a trapezoidal shape, rather than the square shape of the green compacts Q. The inventors discovered that these deformations are particularly apparent for green compacts made of cemented carbide or cermet.

Applicants' invention as claimed in amended independent claim 18 is directed to exploit this phenomenon. Specifically, the invention is directed to manipulating one or more physical properties of the green compacts (i.e., a "density gradient" or a "dimensional gradient") and controlling a placement orientation of the green compacts on the sintering plate in such a way as offset the non-uniform shrinkage produced by the sintering process.

Applicants' invention claims material density as a physical property that can be exploited in this manner. Specifically, the green compacts may be formed such that the material density decreases along a direction proceeding across the green compact (i.e., creating a "density gradient"). By orienting the green compacts such that the side of the green compact having the lowest density in each case is outwardly positioned closest to the circumference of the sintering plate, the deformation effect along the direction of the gradient (i.e., toward the circumference of the sintering plate) is reduced to offset the effects of the sintering process (see, e.g., page 27, line 9 through page 28, line 6, page 46, lines 1 - 24 of Applicants' specification, and Applicants' FIG. 9). As illustrated in FIG. 9, deformation is reduced such that the both the green compact and the throwaway tip subjected to the sintering process have a square shape.

Applicants' invention also claims shape as another physical property that can be exploited to offset the non-uniform shrinkage resulting from the sintering process. Specifically, if the shape of the green compact is selected to differ in a particular way from the shape to be given to the throwaway tip, the desired offset can be achieved. For example, if a green compact is produced in a trapezoidal shape, and is oriented such that its longest edge is positioned closest to the center of the sintering plate and its shortest edge is positioned farthest from the center of the sintering plate (i.e., thereby creating a "dimensional gradient"), deformation of the trapezoidal shape during sintering results in a throwaway tip having square shape (see, e.g., page 20, line 16 through page 21, line 13 of Applicants' specification, and Applicants' FIG. 3).

In summary, Applicants invention as claimed provides a method with which it is possible to obtain throwaway tips with high dimensional precision and accuracy by exploiting physical properties of the green compacts in a manner that offsets the deformation produced by

conventional sintering processes. As is further discussed below, Applicants' submit that their claimed method is neither taught nor contemplated by the prior art.

Rejection in View of Tokuhara

The Examiner contends that Tokuhara discloses a method of forming a sintered compact comprising: filling a die; compacting to form a green compact; placing the compact on a sintering plate; and sintering the compacts to form a sintered compact. The Examiner asserts that, because Tokuhara's green compacts are arranged in an array on the sintering plate so that sintering is applied in a directional manner, this configuration would "inherently result in directional gradients in the green compacts due to the differential heating rates of the green compacts."

Applicants amend independent claim 18 to specify that each of the green compacts is formed to have at least one of a density gradient or a dimensional gradient of the difference between the green compact and the sintered article, and that it is this gradient that is claimed and characterized as decreasing across the green compact in a predetermined direction

Each of the density gradient and the dimensional gradient are characteristics that are established as a result of Applicants' filling and press forming steps, which are performed prior to sintering. For example, Applicants' steps may create a green compact having a density gradient by controlling the quantity of raw material provided across the press forming die (see, e.g. page 10, line 22 - page 12, line 1 of Applicants' specification). A dimensional gradient may be formed by forming the cross sectional shape of the die so that the dimensions of the green compact opposing ends of the die are proportionately different from the dimensions desired in the finished, sintered tip (see, e.g., page 20, line 16 - page 21, line 13 of Applicants' specification, together with Applicants' FIG. 3).

Applicants submit, in response to the Examiner's assertion, that neither of the claimed density and dimensional gradients results inherently due to the differential heating rates of the green compacts during the sintering process, as the density and dimensional gradients are established for

the green compacts prior to starting the sintering process. Applicants further submit that Tokuhara neither teaches nor suggests any filling and press forming steps that would produce Applicants' claimed density and dimensional gradients. Because Tokuhara fails to teach or suggest such gradients, Applicants in addition submit that Tokuhara must also fail to teach or suggest Applicants' claimed step placing the green compacts on a sintering plate such that substantially the green contacts are oriented with the density or dimensional gradient decreasing outwardly from the center of said sintering plate.

For at least the above-argued reasons, Applicants submit that Applicants' method as claimed in amended independent claim 18 is not obvious in view of Tokuhara, and stands in condition for allowance. As independent claim 27 has also been amended to specify that each of the green compacts has at least one of a density gradient or a dimensional gradient that is characterized as decreasing across the green compact, Applicants submit that amended independent claim 27 is not obvious in view of Tokuhara for at least the same reasons, and stands in condition for allowance. As each of claims 19 - 26, 28 - 37, 42 and 52 depends from one of allowable independent claims 18 and 27, Applicants submit that dependent claims 19 - 26, 28 - 37, 42 and 52 are also allowable for at least this reason.

Therefore, Applicants respectfully request that the rejection of claims 18 - 37, 42 and 52 under 35 USC §103(a) be withdrawn.

New Claims

Applicants add new claim 68, which includes the limitations of former claim 61 and now depends from amended independent claim 61. As amended independent claim 61 is allowable, Applicants submit that new claim 68 is also allowable for at least this reason.

Applicants also add new claim 69, depends from amended independent claim 60. As amended independent claim 60 is allowable, Applicants submit that new claim 69 is also allowable for at least this reason. Applicants further submit that new claim 69 is also allowable for an additional reason.

New claim 69 further specifies that the conveyance mechanism for holding and conveying the plurality of green compacts to be placed on said sintering plate has a second rotation mechanism for rotating each held green component around an axis of the conveyance mechanism. Applicants submit that none of the cited references, alone or in combination, disclose or otherwise suggest Applicants' alignment apparatus as claimed in new claim 69 as having both a sintering plate having a first rotation mechanism and a conveyance mechanism having a second rotation mechanism.

CONCLUSION

Each and every point raised in the Office Action mailed December 12, 2007 has been addressed on the basis of the above amendments and remarks. In view of the foregoing it is believed that claims 18 - 37, 42, 52 and 60 - 69 are in condition for allowance, and it is respectfully requested that the application be reconsidered and that all pending claims be allowed and the case passed to issue.

If there are any other issues remaining which the Examiner believes could be resolved through a Supplemental Response or an Examiner's Amendment, the Examiner is respectfully requested to contact the undersigned at the telephone number indicated below.

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Respectfully submitted,

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